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ABSTRACT

This module, one of 25 on vocational education training for careers in environmental health occupations, contains self-instructional materials on obtaining heat stress measurements. Following guidelines for students and instructors and an introduction that explains what the student will learn are three lessons: (1) naming and describing the functions of the sections or parts of the dry bulb, wet bulb, and globe thermometers; and assembling and using the wet bulb and globe thermometers; (2) assembling a wet bulb globe temperature apparatus; and (3) determining the wet bulb globe temperature using a Botsball thermometer. Each lesson contains objectives, recommended methods and locations for practice, performance criteria, equipment and supplies to perform a task, detailed step-by-step instructions for learning a task, and performance exercises. Three performance tests cover using dry bulb, wet bulb, and globe thermometers; assembling and using the wet bulb globe temperature apparatus; and using a Botsball heat stress indicator. (CT)

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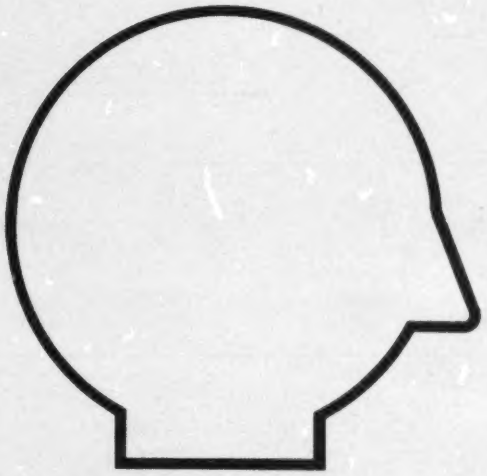

Obtaining Heat Stress Measurements

Module 15

CE029497

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FOREWORD

The Curriculum and Instruction Branch of the Office of Vocational and Adult Education, U.S. Department of Education, identified a need to improve the training opportunities for vocational education students interested in pursuing careers in environmental health. To fulfill that need, Consumer Dynamics, Inc., a Rockville, Maryland, based company, was awarded the contract to develop performance-oriented, competency-based modules in the environmental health sciences.

OBTAINING HEAT STRESS MEASUREMENTS is one of the modules in the series, "Vocational Education Training in Environmental Health Sciences." The module content is based on selected materials in the environmental health field. The module is intended to supplement existing course materials.

CONTENTS

FOREWORD.....i

USING THESE SELF-INSTRUCTION MATERIALS.....1
Guidelines For Students.....1
Guidelines For Instructors.....2

INTRODUCTION.....4
Background.....4
What You Will Learn.....5

LESSON ONE.....6
Objective.....6
Where And How To Practice.....6
How Well You Must Do.....6
Things You Need.....6
Getting There--Steps.....8
Exercises.....12
Films And Slide/Tape Programs.....13

LESSON TWO.....14
Objective.....14
Where and How To Practice.....14
How Well You Must Do.....14
Things You Need.....14
Getting There--Steps.....15
Exercises.....20

LESSON THREE.....21
Objective.....21
Where And How To Practice.....21
How Well You Must Do.....21
Things You Need.....21
Getting There--Steps.....22
Exercises.....26

PERFORMANCE TEST.....28
Using Dry Bulb, Wet Bulb, And Globe Thermometers.....28
Assembling And Using The WBGT Apparatus.....29
Using A Botsball Heat Stress Indicator.....30

REFERENCES.....32

USING THESE SELF-INSTRUCTION MATERIALS

This self-instruction learning package or module is designed to allow both students and instructors flexibility of use. Although primarily intended for use in existing training programs, the module can be used by anyone interested in learning new skills or perking up old ones. Therefore, two sets of guidelines are presented--one set addressed to students and the other set addressed to instructors. First, find out how you, the student, should use the materials in this book.

GUIDELINES FOR STUDENTS

Take the Performance Test as a pretest.

When you pick up this book and work through it, your goal will not be a letter grade or a high score on an exam. Instead, you will work to develop skills that you can demonstrate. You will not have to worry about how well someone else is doing. Before you start work on this module, you should, first, find out if you have sufficient skills to start training by reading through the section called PERFORMANCE TEST. If you think you can do all or most of the items in this test, ask your instructor to obtain the necessary equipment and supplies. Although you do not need any special preparation before entering training provided in this module, you should have completed at least one high school science course.

Work on parts you need to practice.

If you do everything well, according to the criteria in the Performance Test guidelines, you will not need to spend time working on this module. If after taking the Performance Test you discover there are parts you need to practice, follow the key to each item in FOR FURTHER STUDY.

Work straight through each lesson in the order presented.

Should you decide to completely work through this module, begin with the INTRODUCTION and go straight through each of the three lessons. The lesson begins with the OBJECTIVE of the training. Follow the instruction for each part in the order presented. Practice each step in a lesson until you can do it according to the criteria stated for the step. At the end of a lesson, do the EXERCISES. When there are audiovisuals listed at the end of a lesson, ask your instructor for help in obtaining them.

USING THESE SELF-INSTRUCTION MATERIALS

Take the Performance Test as a posttest.

Finally, after you have mastered all of the exercises in each lesson, ask your instructor to watch you collect information specified in the Performance Test, which can be used as a posttest to evaluate the quality of your performance. Turn now to the Performance Test.

GUIDELINES FOR INSTRUCTORS

Approach

The approach of these materials is to provide the student with (1) nomenclature and procedures for assembling wet bulb and globe thermometers; (2) procedures for setting up and using apparatus and equipment to determine WBGT; and (3) procedures for using a Botsball thermometer. The lessons are sequential in that the information presented in the previous lesson serves as a basis for skill development in a later lesson. Exercises are provided to guide the student's practice of the procedures in GETTING THERE--STEPS.

Use of the Performance Test

A Performance Test is provided to serve as a guide to the skill development progress. If a student is able to demonstrate skill development by meeting the criteria for performance given in each test item, further study is not needed. Therefore, the student should be given the option of entering training at any point. To determine at what point to start, the student should take the Performance Test as a pretest. At any time during the course of study the student should also be allowed to test out of the remaining portions of training.

Also, the student's capability to accurately complete the entire task in a timely manner can be evaluated by using the Performance Test as a posttest.

Specific Instructions

The Vernon Globe Thermometers are not available commercially, and, therefore, must be homemade. They can be fabricated out of a copper toilet tank float and a #2 rubber stopper or, preferably, from a 6" copper sphere and a 1" piece of 1/2"-diameter copper tubing.

The globe must be painted flat black and the rubber stopper should be bored out to accommodate the diameter of the 50°-212° F mercury thermometer.

Specifications for building a NIOSH-type apparatus are shown in Lesson Three, Key Point 6, figure 1. This is the actual type of instrument used in the field by industrial hygienists. However, a simpler version can be constructed using a laboratory ringstand and support clamps as shown in Lesson Two, Key Point 1.

INTRODUCTION

BACKGROUND

Extremes of temperature, pressure, mechanical vibration, and repeated motion, as well as exposures to radiation and noise, produce stresses on the worker. These stresses are as important to the well-being of the worker as are the chemical and biological hazards.

Probably the most elementary factor of environmental control is control of the thermal (heat) environment in which people work. General experience has shown that extremes of temperature affect the amount of work that people can do and the manner in which they do it. The industrial problem is more often that of exposure to high temperatures rather than to low temperatures.

Heat stress is a commonly recognized work environment problem. Evaluation of heat stress is not simple or easy. Considerably more is involved than simply taking the temperature of the room. In many heat stress studies the variables commonly measured are work energy metabolism (how much energy is being expended by the worker), air temperature, air movement, humidity, and radiant heat.

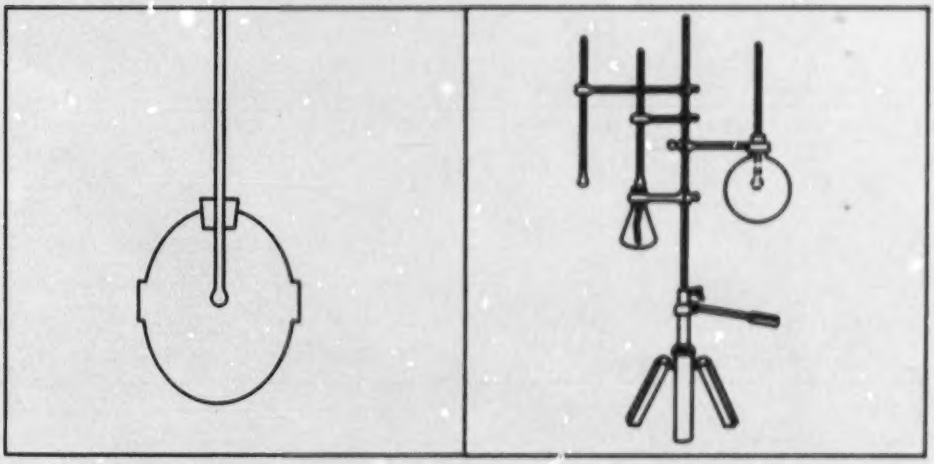
Air temperature and movement are variables that can be measured with relative ease. Air movement is measured with some type of anemometer, and the temperature is measured with a thermometer, often referred to as a "dry bulb" thermometer. Humidity, or moisture content of the air, is generally measured with a psychrometer, which gives both dry bulb and wet bulb temperatures. Using these temperatures and referring to a psychrometric chart, the relative humidity can be established

The schemes commonly used to estimate heat stress-related variables attempt to derive one number that serves as a guide for evaluating environmental heat stress. For example, the "effective temperature index" combines three variables (temperature, humidity, and air movement) to produce a single index called an "effective temperature."

INTRODUCTION

WHAT YOU WILL LEARN

When you finish working through the steps and exercises in this module you will be able to take accurate measurements with the wet bulb, dry bulb, and globe thermometers. You will also be able to use these measurements to calculate the wet bulb globe temperature (WBGT).



You will learn these procedures in three lessons:

- o Lesson One

  You will be able to name and describe the functions of the sections or parts of the dry bulb, wet bulb and globe thermometers, and be able to assemble and use the wet bulb and globe thermometers.

- o Lesson Two

  You will be able to assemble a wet bulb globe temperature (WBGT) apparatus and use it to measure WBGT.

- o Lesson Three

  You will be able to determine the WBGT using a Botsball thermometer.

LESSON ONE

OBJECTIVE

You will be able to name and describe the functions of the sections or parts of the dry bulb, wet bulb and g'obe thermometers, and be able to assemble and use the wet bulb and globe thermometers.

WHERE AND HOW TO PRACTICE

You should practice doing this lesson on a table or desk where there is room to spread out instruments and this module. Read through each step before attempting to do it, and make sure you can perform the step as well as described in "How Well You Must Do." Practice labeling and naming parts by using the diagrams in "Exercises."

HOW WELL YOU MUST DO

You must be able to name and describe the functional parts of the wet bulb, dry bulb, and globe thermometers within 5 minutes. You must also be able to read each thermometer within $\pm 0.5^{o}$ F.

THINGS YOU NEED

- 1 mercury thermometer 50^{o}-212^{o} F
- 2 mercury thermometers 20^{o}-100^{o} F
- 1 "Vernon Globe" thermometer (either a copper toilet tank float or a 6" hollow copper sphere painted flat black fitted with a 1" piece of 1/2" diameter copper tubing)
- 1 #2 rubber stopper bored to accommodate the 50^{o}-212^{o} F thermometer
- 1 125-ml Erlenmeyer flask
- 100 ml distilled water
- piece of hollow, white, cotton shoestring or wet bulb thermometer wicking
- 6-10" bare copper wire #24-20 AWG
- diagonal wire cutter

THINGS YOU NEED (cont'd)

- laboratory ringstand with thermometer clamp
- 12" ruler.

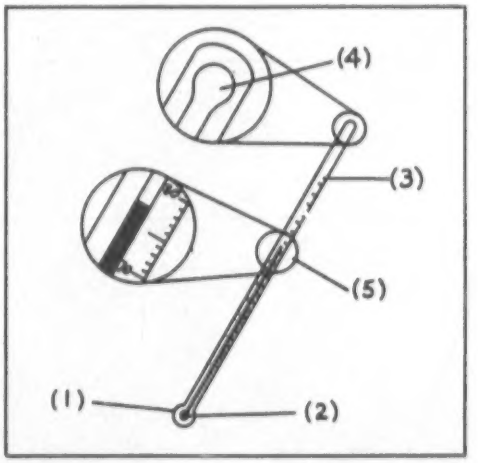
Instructions: Now turn to the next page and begin work on Lesson One, "Getting There--Steps."

GETTING THERE--STEPS

STEP 1

A DRY BULB THERMOMETER registers the temperature of air surrounding the bulb (1). When the temperature of that air rises, it causes the mercury (2) to expand and rise in the tube (3). If not overheated too much, the mercury will expand into the safety chamber (4) without breaking the thermometer. Read the Fahrenheit thermometer scale (5) to within $\pm 0.5^{0}$ F.

KEY POINT 1

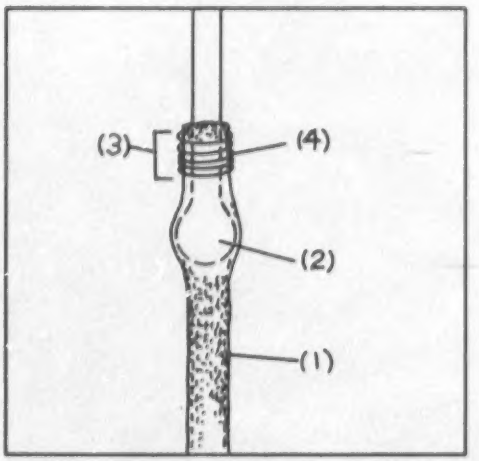


Read only the temperature of dry air with the dry bulb thermometer.

STEP 2

To measure humidity assemble a WET BULB THERMOMETER. Start by cutting off a 2- to 3-inch piece of shoestring (1) or commercially available wet bulb wick. Slide it over the bulb (2) of the 20^{0}-100^{0} F mercury thermometer. Position the wick so it is between 1/2 to 3/4 of an inch above the bulb (3). Cut a 1-1/2-inch piece of uninsulated bare copper wire (4). Wrap the wire around the tube as shown in the Key Point.

KEY POINT 2

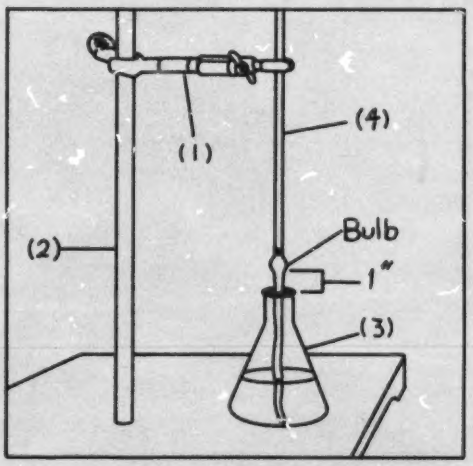


Wrap a piece of wire around the wick positioned 1/2 to 3/4 inches above the bulb.

STEP 3

Attach the thermometer clamp (1) to the ringstand (2). Add distilled water to the flask (3). Dip the wet bulb thermometer you assembled in Step 2 into the water until the entire wick is saturated. Place the thermometer (4) in the clamp and adjust the clamp so the bulb is positioned about 1 inch above the neck of the flask.

KEY POINT 3

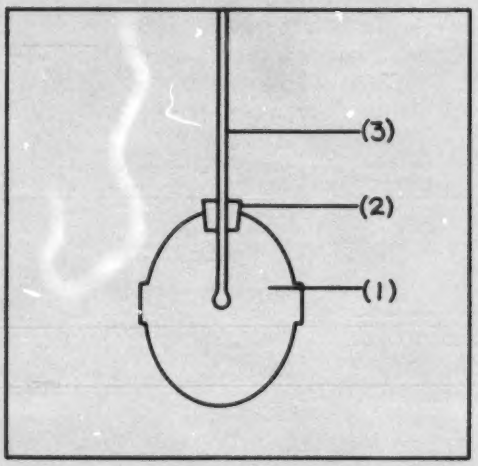


After saturating the wick, adjust the thermometer so the bulb is positioned 1/2 inch above the neck of the flask.

STEP 4

The GLOBE THERMOMETER measures heat that is transferred through wave-form energy from heat sources such as the sun, open flames, or molten metal. Until heat waves strike an object, the object is unaffected by the heat source. The globe thermometer, which is the object used to measure radiant heat, usually consists of a black-painted copper toilet float (1), a one-hole stopper (2), and a dry bulb thermometer (50^{0}-212^{0} F) (3).

KEY POINT 4



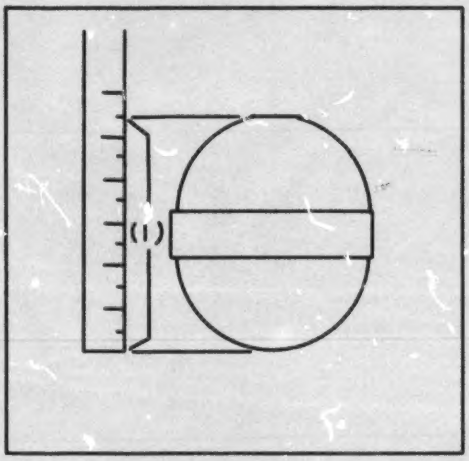
The globe thermometer is used to measure radiant heat.

STEP 5

Assemble the globe thermometer, also known as the Vernon Globe Thermometer. To determine how far to insert the thermometer into the globe, first measure the height (l) of the globe. Record that measurement here:

_____

KEY POINT 5

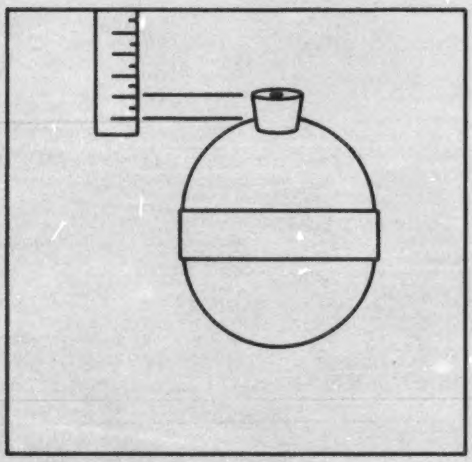


Find the height of the globe.

STEP 6

Place the stopper into the hole in the globe until a snug fit is obtained. Measure the height of the stopper protruding out of the globe. Record that measurement here:_____

KEY POINT 6

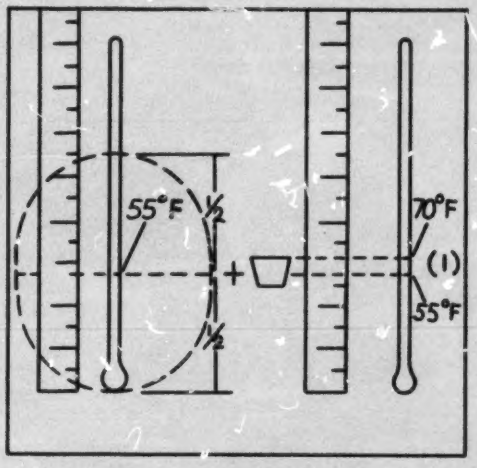


Find the height of the protruding stopper.

STEP 7

From the tip of the thermometer, measure up one-half the height of the globe. Add to that the measurement you made in Step 6. Note here the point on the thermometer scale that corresponds to the total measurement: _____ ° F (1). The top of the stopper will rest on this mark.

KEY POINT 7

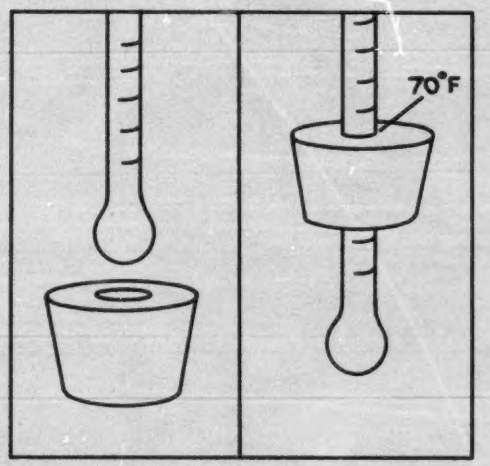


Find the degree mark on the thermometer where the top of the stopper will rest.

STEP 8

Coat the bulb end of the thermometer with an extremely thin film of stopcock grease to make it easier to slide the rubber stopper onto the thermometer. With a twisting motion insert the bulb end of the thermometer into the stopper and push it up onto the tube until the top of the stopper is even with the degree line you recorded in Step 7 (1).

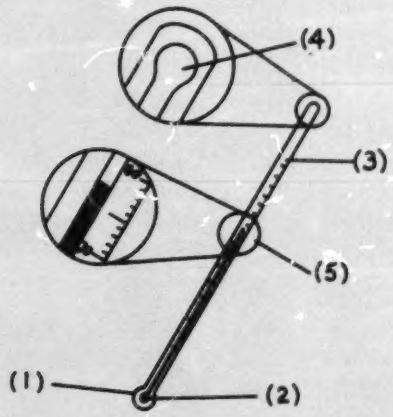
KEY POINT 8

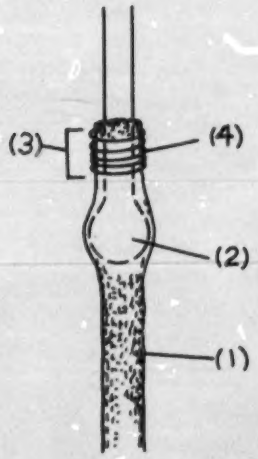


Push the stopper onto the thermometer tube until it is even with the degree line.

EXERCISES

Instruction 1: Identify the parts of the following thermometers. Explain what each part does and explain the application of the thermometers.





Instruction 2: Practice taking dry bulb measurements in rooms of different temperature. Record your measurements on the data sheet provided at the end of this lesson.

Instruction 3: Repeat Instruction #1, using the wet bulb and globe thermometers. If possible, try to make some measurements in areas where there is high humidity (laundries, indoor swimming pools and shower rooms) and radiant heat sources (boiler rooms, foundry shop, etc.). Record your measurements on the data sheet provided.

NAME _____ DATE _____

Time	Measurement Location	Dry Bulb	Wet Bulb	Globe Temp.

Instruction 4: Compare the three different measurements made at the same location at the same time. Describe any differences you observed in the readings here:

_____

_____

_____

_____

_____

FILMS AND SLIDE/TAPE PROGRAMS

"If You Can't Stand the Heat," U.S. Naval Medical Film Library, Bethesda Naval Medical Center, Bethesda, MD.

"The Heat Stress Monster", U.S. Naval Medical Film Library, Bethesda Naval Medical Center, Bethesda, MD.

LESSON TWO

OBJECTIVE

You will be able to assemble a wet bulb globe temperature (WBGT) apparatus and use it to measure WBGT.

WHERE AND HOW TO PRACTICE

Continue using the area you selected for practicing Lesson One. Before doing any assembly work read the entire step. If you have any questions about how to perform any step in this lesson, request help from your instructor.

HOW WELL YOU MUST DO

You must be able to assemble the WBGT appartus within 10 minutes. Collect temperature data and use the data to calculate the wet bulb globe temperature (WBGT) to within $\pm 0.5^{o}$ F.

THINGS YOU NEED

In addition to the equipment and supplies you used in Lesson One, you will need the following:

- o photographer's tripod
- o tape measure or folding ruler at least 5 feet long
- o aluminum foil, 1x1 ft
- o scissors.

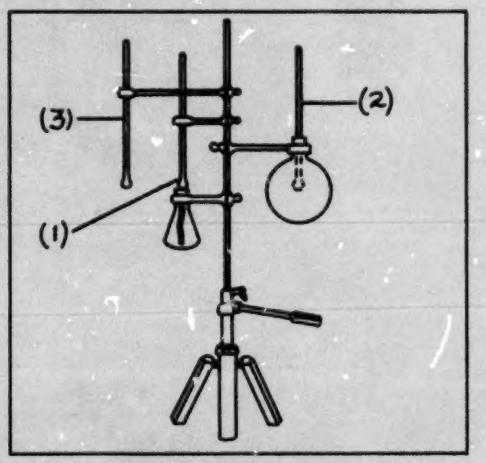
Instructions: Now turn to the next page and begin work on Lesson Two, "Getting There--Steps."

GETTING THERE--STEPS

STEP 1

Assemble the heat stress apparatus as shown in Key Point 1 using the wet bulb (1) and globe (2) thermometers you assembled in Lesson One. Also, clamp a dry bulb thermometer (3) to the apparatus.

KEY POINT 1

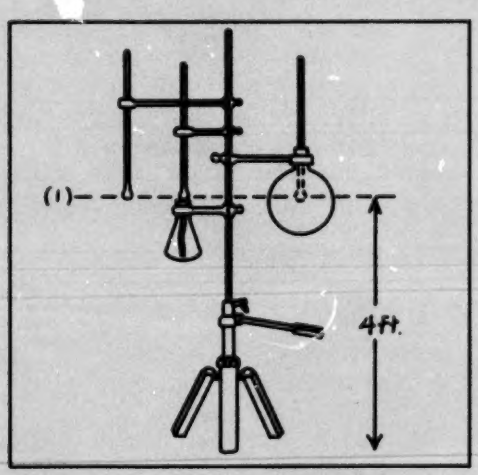


Clamp the dry, wet, and globe thermometers to the stand.

STEP 2

Using your tape measure, adjust the tripod so the centerline of the thermometer bulbs is 4 feet ±1 inch above the floor (1).

KEY POINT 2

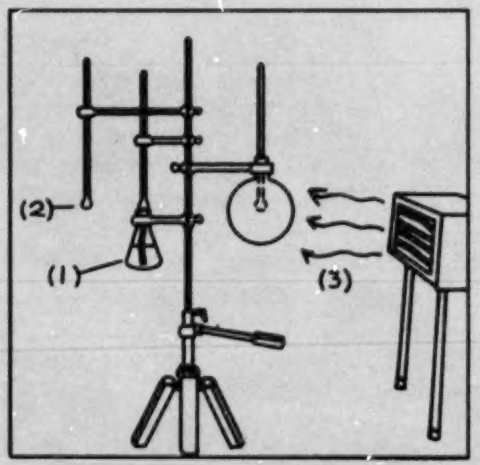


Adjust the thermometer and tripod so that the centerline of the bulbs is about 4 feet above the floor.

STEP 3

Check to ensure that the wet bulb wick is saturated (1), the wet bulb is 1/2 inch above the neck of the flask (2), and the globe is not shielded from radiant heat sources (3).

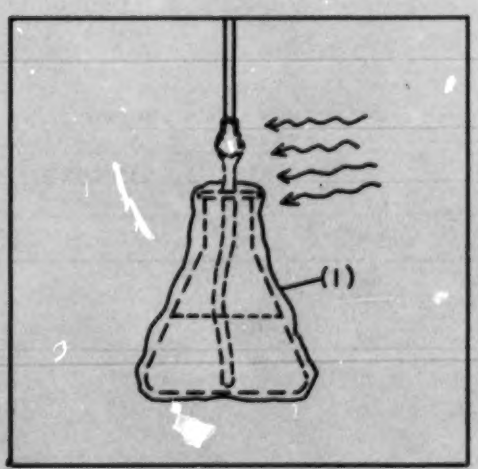
KEY POINT 3



STEP 4

If there is a strong radiant heat source (hot metal, electric heater, etc.) nearby, you will have to shield the wet bulb thermometer with a piece of aluminum foil (1). Wrap the wet bulb thermometer assembly as shown in Key Point 4.

KEY POINT 4



Wrap flask and thermometer with aluminum foil to protect them from radiant heat sources.

STEP 5

Before taking any measurements, allow 30 minutes for the thermometers to adjust to the ambient (general) temperature of the area you are surveying.

KEY POINT 5

Allow thermometers to adjust prior to taking measurements.

STEP 6

During the time the instrument is adjusting, obtain information you will need to record on the data collection sheet found at the end of the lesson. If you are taking measurements in an actual plant setting, this is usually a good time to talk to employees about their work duties to ask how long and how many work periods are spent in hot environments, and to determine how many rest periods they take during a workshift.

KEY POINT 6

Obtain information about the employees while the thermometers are adjusting.

STEP 7	KEY POINT 7
After 30 minutes, read the dry bulb, the wet bulb, and the globe thermometers. Record your readings in the appropriate section of the form provided at the end of the lesson. (Make a photocopy of this form for use in the exercises at the end of this lesson.) Make these measurements in both the work and rest areas.	After 30 minutes, record the readings.
STEP 8	KEY POINT 8
Calculate the WBGT from the data collected in Step 7. If the measurements are made indoors, use equation A in which: Equation A WBGT = 0.7 x Natural Wet Bulb (NWB) temperature + 0.3 x Globe Temperature (GT) If measurements are made outdoors, use equation B, which includes the Dry Bulb (DB) temperature: Equation B WBGT = (0.7 x NWB) + (0.2 x GT) + (0.1 x DB).	Calculate the WBGT with the indoor or outdoor formula.

HEAT STRESS DATA COLLECTION SHEET

BACKGROUND DATA

Company Name_____

Employee_____ I.D. No._____

Job Title_____

Date_____ Time_____ Observer_____

Start Time_____ Stop Time_____

Duration of Exposure for One Job Cycle_____Minutes

Number of Cycles per Shift_____

Workload: Light_____ Moderate_____ Heavy_____

Work Rest Regime: Work Time_____(min) Rest Time_____(min)

Location of Rest Area_____

Rest Area Temperatures ____° F DB ____° F NWB ____° F GT

Clothing Worn By Employee_____

_____

_____

MEASUREMENT DATA

Thermometer Readings ____° F DB ____° F NWB ____° F GT

CALCULATIONS

(A) Indoors WBGT = 0.7 (NWB) + 0.3 (GT)
= 0.7 ( ) + 0.3 ( ) =

(B) Outdoors WBGT = 0.7 (NWB) + 0.2 (GT) + 0.1 (DB)
= 0.7 ( ) + 0.2 (GT) + 0.1 ( )

EXERCISES

Instruction 1. Practice making WBGT measurements in other rooms as well as outside. If possible, try to obtain measurements in areas of high heat and high humidity such as boiler rooms, laundries, cafeteria kitchens, shower rooms, and indoor swimming pools. Record these data on the data collection sheet.

Instruction 2. If there are other students in your section working on this module, compare measurement data for tests made in different locations in the same room at the same time.

LESSON THREE

OBJECTIVE

You will be able to determine the WBGT using a Botsball thermometer.

WHERE AND HOW TO PRACTICE

Continue using the area that you selected for practicing Lessons One and Two. If you have any questions about how to perform any step in the lesson, request help from your instructor.

HOW WELL YOU MUST DO

You must be able to set up the Botsball thermometer and compare measurements obtained from it with WBGT values.

THINGS YOU WILL NEED

In addition to the WBGT apparatus from Lesson Two, you will need the following:

- Botsball thermometer
- 125-ml plastic wash bottle
- 100 ml of distilled water.

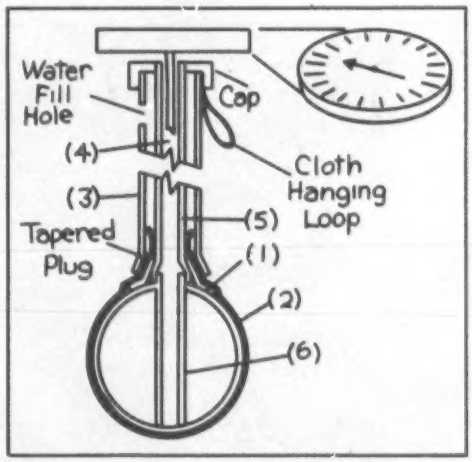
Instructions: Now turn to the next page and begin work on Lesson Three, "Getting There--Steps."

GETTING THERE--STEPS

STEP 1

Pick up the Botsball and compare it to the figure at the right and identify the parts. The Botsball consists of a 2-3/8" hollow copper sphere (1) that is painted black and covered with a double layer of black cloth (2). The cloth covering is continuously kept wet by water seeping from the aluminum reservoir tubes (3) attached to the globe. To increase the flow, pull the reservoir tubes away from the globe; to decrease the flow, push them together. The stem (4) of a dial thermometer passes through a plastic tube (5) along the centerline of the water reservoir tube and into the thermometer well (6).

KEY POINT 1



Identify the parts of the Botsball.

STEP 2

Fill the plastic squeeze bottle with water. Distilled water is recommended to prevent dissolved solids, normally found in tapwater, from depositing on the cloth covering.

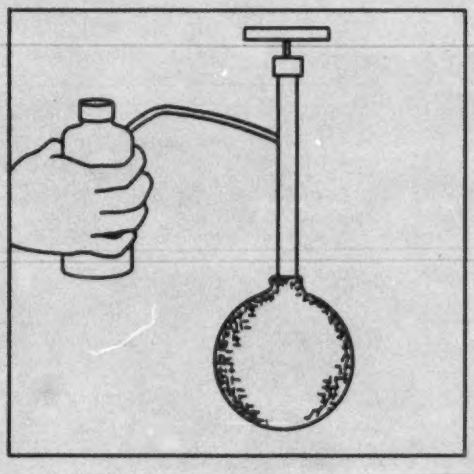
KEY POINT 2

Use distilled water in the Botsball.

STEP 3

Use the squeeze bottle to fill the water reservoir of the globe assembly through the fill hole in the side of the reservoir tube near the top.

KEY POINT 3

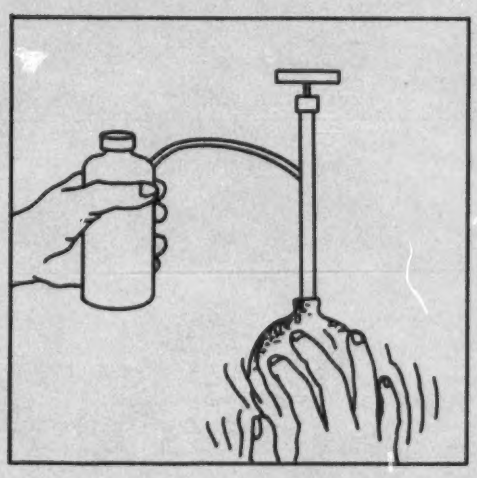


Fill the reservoir with distilled water.

STEP 4

Be sure the cloth covering of the globe is wetted thoroughly. Squirt water from the squeeze bottle onto the cloth, rub the water into the cloth with your fingers, or dip the globe into water.

KEY POINT 4



Saturate the cloth globe with water.

STEP 5

Part of the cloth cover is gathered inside the reservoir. To make sure it is thoroughly wetted, gently pull the reservoir tube upward away from the globe to allow water to flow out of the reservoir.

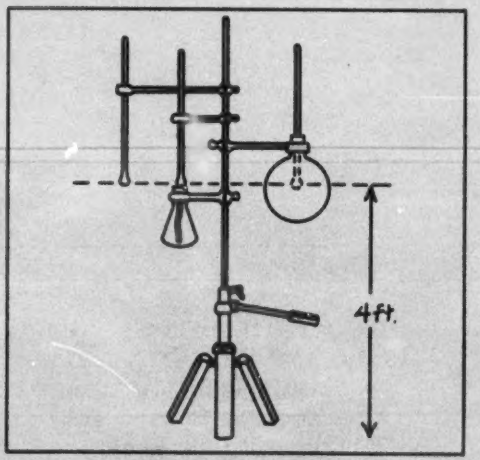
KEY POINT 5

Check the cloth under the reservoir to be sure that it is wet.

STEP 6

Arrange the clamps as shown in the Key Point. Attach the Botsball to the laboratory ringstand with a ringstand clamp. Adjust the clamp to raise or lower the Botsball so that its centerline is about 4 feet above the floor.

KEY POINT 6

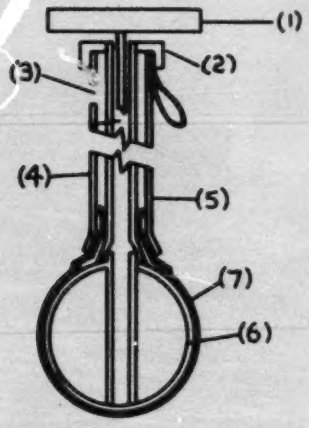


Adjust all clamps so that the centerline of each component is 4 feet from the floor.

STEP 7	KEY POINT 7
Allow a 5-minute adjustment period. Keep the cloth covering wet, and use this time as you did in Lesson Two to fill in the data collection sheet.	Allow 5 minutes for adjustment; keep the cloth wet.
STEP 8	KEY POINT 8
At the end of the 5-minute adjustment period, read and record the Botsball reading in the space provided on the data collection sheet. The reading you get may approximate the WBGT number you calculated in Lesson Two.	Record the Botsball reading after 5 minutes.

EXERCISES

Instruction 1: Correctly label each of the following parts of the Botsball. Tell your instructor how each part works.



(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
(7) _____

Instruction 2: Using the Botsball, conduct measurements in the same locations as in Lesson Two. Record your measurements on the data collection sheet at the end of the exercises.

Instruction 3: Ask your instructor to obtain different heat stress monitors such as one or more of the following:

RSS-211D Heat Stress Monitor
Reuter Stokes, 465 Dobbie Drive, Cambridge, Ontario CAN
N1R 5X9

Model 218 WBGT Kit Weksler Instrument Corp.
Freeport, NY 11520

Bendix WBGT Bendix Process Instrument,
Drawer 831, Lewisburg, WV 24901

LESSON THREE/EXERCISES

DATA COLLECTION SHEET

Time	Location	DB	WB	GT	WBGT	Botsball	Comments

PERFORMANCE TEST

Instructions: Check your skill level or progress by working through each of the items in this test. If you can perform each item as required, place a check in the space provided. When all of the items are checked, you are ready to demonstrate your skill to your instructor. You will be considered trained in a skill after your instructor approves your performance of each of the following items:

USING DRY BULB, WET BULB, AND GLOBE THERMOMETERS

No. 1____ Explain the purpose of the dry bulb thermometer.

No. 2____ Explain the purpose of the wet bulb thermometer.

No. 3____ Construct a wet bulb thermometer, using a mercury thermometer, wicking, a piece of copper wire, a ringstand, a flask, and a clamp.

No. 4____ Explain the purpose of the globe thermometer.

No. 5____ Using a thermometer, a rubber stopper, and a hollow copper globe, construct a globe thermometer so that the tip of the thermometer is aligned with the centerline of the globe.

No. 6____ Read each of the three thermometers described above to within $\pm 0.5^{\circ}$ F.

FOR FURTHER STUDY

If you could not perform one or more of the six items above, review and practice the following lesson steps:

No. 1
Lesson One, Step 1

No. 2
Lesson One, Step 2

No. 3
Lesson One, Steps 2 and 3

No. 4
Lesson One, Step 4

No. 5
Lesson One, Steps 5 through 8

PERFORMANCE TEST

No. 6
Lesson One, Step 1

ASSEMBLING AND USING THE WBGT APPARATUS

No. 1____ Assemble within 10 minutes the heat stress apparatus, using previously assembled wet bulb and globe thermometers.

No. 2____ Raise the apparatus to within ±1 inch of the test level.

No. 3____ Demonstrate how to check the measurement conditions of the wet bulb.

No. 4____ Demonstrate how to check the measurement conditions of the globe.

No. 5____ Demonstrate how to shield the wet bulb thermometer from radiant heat sources using aluminum foil.

No. 6____ Tell how long you should let the apparatus adjust to the ambient temperature before taking a reading.

No. 7____ Demonstrate how to collect WBGT data.

No. 8____ Calculate a WBGT index to within ±0.5° F.

FOR FURTHER STUDY

If you could not perform one or more of the eight items above, review and practice the following lesson steps:

No. 1
Lesson Two, Step 1

No. 2
Lesson Two, Step 2

No. 3
Lesson Two, Step 3

No. 4
Lesson One, Steps 5 through 8

No. 5
Lesson Two, Step 4

PERFORMANCE TEST

No. 6
Lesson Two, Step 5

No. 7
Lesson Two, Step 6 and 7

No. 8
Lesson Two, Step 8

USING A BOTSBALL HEAT STRESS INDICATOR

No. 1____ Name the major parts of the Botsball and explain the purpose of each.

No. 2____ Fill the Botsball with water.

No. 3____ Saturate the globe with water.

No. 4____ Demonstrate how to control the flow of water from the reservoir.

No. 5____ Tell how long the Botsball should adjust before making a measurement.

No. 6____ Attach and adjust the Botsball to the WBGT apparatus to obtain measurements at the same location at the same time.

No. 7____ Allow the Botsball to adjust and make a measurement.

FOR FURTHER STUDY

If you could not perform one or more of the seven items above, review and practice the following lesson steps:

No. 1
Lesson 3, Step 1

No. 2
Lesson 3, Step 3

No. 3
Lesson 3, Step 4

No. 4
Lesson 3, Steps 5 and 8

PERFORMANCE TEST

No. 5
Lesson 3, Step 7

No. 6
Lesson 3, Step 6

No. 7
Lesson 3, Steps 7 and 8

REFERENCES

Criteria for a Recommended Standard...Occupational Exposure to Heat Stress. U.S. DHEW, NIOSH, 1972.

Fundamentals of Industrial Hygiene. J.B. Olishifski and F.E. McElroy (eds.), National Safety Council, Chicago, IL, 1976, pp. 271-99.

Heating and Cooling for Man in Industry. American Industrial Hygiene Association, Akron, OH, 1973.

Patty's Industrial Hygiene and Toxicology. G.D. Clayton (ed.), New York, John Wiley and Sons, 1978, pp. 921-92.

The Industrial Environment--Its Evaluation and Control. U.S. DHEW, Center for Disease Control, NIOSH, 1973, pp. 413-27.